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TITLE: The Histopathology of the Nervous System during the various Periods of Experimental Acute Radiation Sickness. (Gistopatologiya nervnoy sistemy v razlichnyye periody eksperimental'noy ostroy luchevoy bolezni, Russian).

PERIODICAL: Doklady Akademii Nauk SSSR, 1957, Vol 112, Nr 3, pp 422-424 (U.S.S.R.)
Received: 3 / 1957 Reviewed: 4 / 1957

ABSTRACT: The authors studied the morphological structure of the reflectory arch from the receptors by way of the "sensitive conductions" and further along the propagation path of the impulse. On this occasion the coordination of the various parts of the nervous system was taken into account. Experiments were carried out with rabbits: in general the animals were irradiated once by X-rays with a radiation dose of 1000 r and with radioactive cobalt (the applicators containing the radioactive cobalt were fastened immediately on the skull within the area of the forehead and the crown) with an average radiation dose of 50.000 γ-r. Under the effect of the ionizing radiation the classical picture of acute radiation sickness developed in these rabbits, which died after different periods of time as a result of this sickness. The animals irradiated were studied with respect to biochemical hematological and electroencephalographic

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changes as well as with respect to destructions of protective skins.

The present paper contains the data of histological investigation. When dissecting the rabbits which died in the course of various periods of radiation sickness the authors selected pieces of skin, of the tongue, of the liver, of the aortic arch, and of the suprarenal gland, various parts of the alimentary canal, of the spinal marrow with the intervertebral cartilage of the nervus vagus with the ganglionic nodes, of the extended marrow, and of the cerebrum for purposes of histological investigation. The material examined was fixed by means of a 12% neutral formalin.

In the course of primary reactions and during the latent period the authors observed changes in the main- and receptory conductors and in the cells of the sensitive intervertebral nodes. These changes are the beginning of and are indicative of an irritation of the sensitive neurons. Also indications of an irritation of the sensitive conductors and the sensitive cells were observed. These and other changes were described as hystrophic by the authors. However, they are at first insignifi-

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cant and do not yet indicate a major disturbance of the sensitive neurons. These distrophic changes become aggravated at the outbreak of sickness. During the enture duration of the radiation sickness the nervous system is not diffusely disturbed and the parts affected most are the viscero-receptive system, the sensitive ganglionic cells, and several others. It is above all the vegetative nervous system that suffers.(No illustrations)

ASSOCIATION: Scientific Institute of Research for Radiology and Oncology of the Ministry of Health of the Armenian SSR.
PRESENTED BY: ORBELI,L.A., Member of the Academy.
SUBMITTED: 30.5.1956
AVAILABLE: Library of Congress.

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TITLE: Changes in function and morphology in a number of organs and systems of Man and animals under the influence of large and small doses of ionizing radiation

SOURCE: Akademiya nauk Armyanskoy SSR. Sektor radiobiologii. Voprosy radiobiologii. v.1, 1960, 19-33

TEXT: The effects of ionizing radiation on the nervous, circulatory and digestive systems were clinically and experimentally investigated. 1) Nervous system. Electroencephalography carried out on 20 patients who were irradiated to the head in doses of 4000-7000 r for the treatment of malignant conditions of the scalp showed the presence of delta waves of 0.4-0.8 sec duration, reduction in the amplitude of the biopotentials, asymmetry of the

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hemispheres and occasionally respiratory and cardiac rhythms. These changes were most marked 24 hours after irradiation and had partly returned to normal after 10 days. Thirty persons suffering from the effects of occupational exposure to ionizing radiation were also studied; the electroencephalograms showed a predominance of rapid potentials indicating excitatory processes (7 patients), low amplitudes and slow rhythms indicating inhibition (11), or did not differ significantly from normal (11 patients). Electroencephalography carried out on 40 rabbits in which severe acute radiation sickness had been produced showed a reduction in amplitudes during the first few hours after irradiation, with slow waves of duration 0.3-0.25 sec. Histologically there was damage to the posterior root ganglia (chromatolysis of neurones) and sensory tracts (varicosity of the axons and vacuolation of the myelin sheaths). After 3 - 7 days there were motor disturbances (salivation, lacrimation, diarrhoea) and tachyrhythmia in the electroencephalogram. Death occurred after 7 - 13 days, and in the later stages the electroencephalographic changes showed some tendency to normalization. In 2 rabbits which recovered and were

examined 9 months after irradiation, the cerebral cortex contained areas where the cells were shrunken and hyperchromatic, or showed hydropic dystrophia with chromatolysis and karyocytolysis. Similar appearances were found in 11 dogs which had survived radiation sickness as the result of intensive treatment. Studies with radioactive methionine carried out in 30 white rats subjected to 200-800 r showed that incorporation into the brain was first accelerated and then depressed. The results of the studies indicate that the central nervous system is very sensitive to ionizing radiation and shows evidence of damage almost immediately. 2) Digestive system. Complex radiological and pathological investigations were carried out on dogs and rats suffering from acute radiation sickness. During the first 24 hours after irradiation the stomach in dogs showed delayed emptying and loss of tone. The contrast medium did not disappear from the stomach and small intestine until the fourth day. A similar effect was noted in rabbits. Autopsy carried out after 72 hours revealed paralytic distension of the stomach, with vacuolation of the myelin sheaths and varicosity and fragmentation of the axons in the

intramural nerve plexuses. There was vascular engorgement in the gastrointestinal tract and liver. In irradiated rats the uptake of labelled methionine was increased during the first 3 hours after irradiation; after 6 hours it declined but still remained higher than control values.
3) Heart and cardiac innervation. In patients receiving a dose of 5000 - 10 000 r from a cobalt source to the head for the treatment of malignant conditions of the scalp there was some reduction in the amplitude of the auricular contractions and a prolongation of systole 4 to 5 days after irradiation. There was a reduction in voltage and deformation of the QRS complex and the T wave. The changes all reverted to normal 10 - 15 days after the end of irradiation. Among 40 persons suffering from the effects of occupational exposure to irradiation, 19 showed enlargement of the heart, reduction in the amplitude of the auricular beat was noted in 12 and blunting of the auricular waves in 9; sinus arrhythmia was present in 12, reduction of the T wave in 5 and absence in 6. In rabbits receiving irradiation to the skull in a dose of 6000 r over a period of 10 days, electrocardiography revealed arrhythmia, reduced voltage and deformation of the waveform; these changes

were at a maximum 10 to 12 days after the beginning of irradiation and then reverted to normal. In 30 rats irradiated with 200-800 r and injected with labelled methionine 1 hour later, increased incorporation into the heart muscle was noted after 1 hour; after 3 - 6 hours it declined, and after 24 hours the rate of incorporation was only 35% of the control value, in animals receiving the highest dose of radiation. Degenerative changes were found in the extra- and intramural cardiac nerves of rabbits given irradiation to the head (up to 50 000 r) or whole body (1000 r).

Conclusion: The three systems investigated are involved in the picture of acute radiation sickness at a very early stage, the nervous system being particularly sensitive.

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